

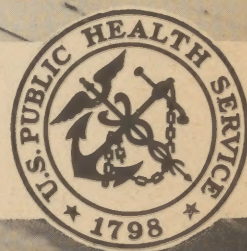
FEDERAL SECURITY AGENCY  
U. S. PUBLIC HEALTH SERVICE  
**Malaria Control in War Areas**  
**FIELD BULLETIN**



THE EXTENDED MALARIA CONTROL PROGRAM

ATLANTA, GEORGIA

JANUARY, 1945



RESTRICTED



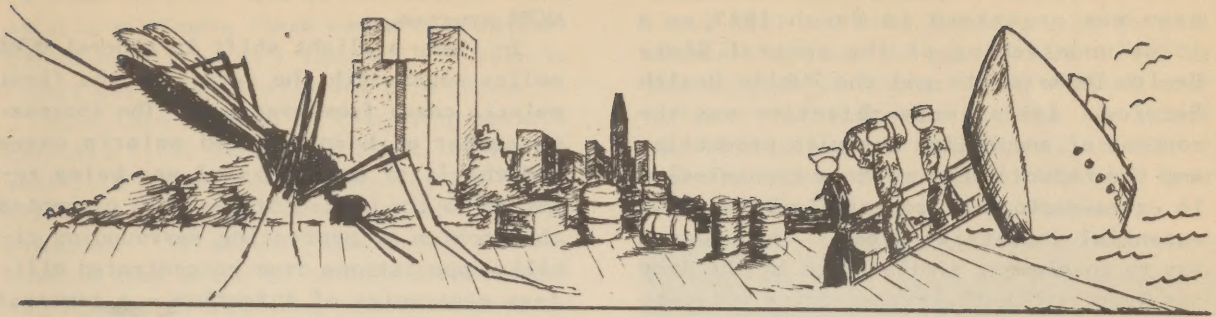
TABLE I

## MCWA LARVICIDE, MINOR &amp; MAJOR DRAINAGE WORK

DECEMBER 1 - 31, 1944

STATE	Areas in Operation	War Establishments Protected	LARVICIDAL WORK				DRAINAGE OPERATIONS										Total Man Hours			
			Larvicide Used		Surfaces Treated		Clearing Removal Surf. Veg. Acres	Clearing Stumping Grubbing Acres	Cleaning Sq. Ft.	Hand Mach.	New Ditching		Ditch Lining Placed Lin. Ft.	Sq. Ft.	Underground Drainage Lin. Ft.	Fill Cu. Yds.			Water Surf. Eliminated Acres	
			Oil Gale.	Paris Green Lbs.	Oiled Acres	Dusted Acres					Lin. Ft.	Dynamite					Total Cu. Yds.			
Alabama	5	92	---	---	---	---	4.3	0.1	136,610	---	1,610	---	---	---	---	---	---	---	0.1	4,092
Arkansas	14	92	---	---	---	---	80.5	10.0	530,340	---	8,030	---	---	---	---	---	---	---	22.0	18,249
California	4	30	---	---	---	---	12.6	---	154,500	---	5,000	---	---	---	---	---	---	---	3.0	3,931
Florida	14	111	90	---	5	---	13.4	1.6	581,991	---	35,930	---	---	---	---	---	---	---	8.874	24,683
Georgia	14	103	---	40	---	---	28.0	0.4	217,056	---	12,793	---	---	---	---	---	---	---	9.0	21,682
Louisiana	8	86	1,186	---	48	---	102.9	1.2	1,057,972	---	27,180	---	---	---	---	---	---	---	5.9	39,029
Maryland	1	32	---	---	---	---	1.2	---	---	---	---	---	---	---	---	---	---	---	---	2,586
Mississippi	10	58	---	---	---	---	51.2	---	152,596	---	5,363	---	---	---	---	---	---	---	1.9	13,136
Missouri	3	22	---	---	---	---	4.2	---	---	---	1,790	---	---	---	---	---	---	---	---	1,876
New York	---	4	---	---	---	---	---	---	750	---	---	---	---	---	---	---	---	---	---	271
North Carolina	9	80	---	---	---	---	26.1	0.1	764,280	---	43,373	---	---	---	---	---	---	---	37.1	26,034
Oklahoma	4	62	---	---	---	---	24.8	---	---	---	5,850	---	---	---	---	---	---	---	15.3	6,566
Oregon	1	7	---	---	---	---	---	0.4	30,260	---	---	---	---	---	---	---	---	---	---	1,088
Puerto Rico	7	22	998	6,560	63	3,916	14.3	1.0	1,106,539	---	8,009	---	---	---	---	---	---	---	36	49,648
South Carolina	17	114	---	---	---	---	18.7	0.4	582,361	---	61,368	---	---	---	---	---	---	---	102	47,956
Tennessee	3	67	---	---	---	---	18.8	---	64,278	---	650	---	---	---	---	---	---	---	63	7,321
Texas	13	178	692	---	39	---	78.9	1.8	579,708	---	24,381	---	---	---	---	---	---	---	133	32,366
Virginia	3	93	---	---	---	---	2.2	---	84,925	---	16,053	---	---	---	---	---	---	---	---	11,449
Total	130	1,253	2,966	6,600	155	3,953	482.1	17.0	6,054,166	---	257,370	---	---	---	---	---	---	---	15,247	311,963
November Total	135	1,300	24,437	10,151	1,444	6,377	698.7	13.3	7,571,165	---	322,602	---	---	---	---	---	---	---	11,322	376,729





## THE EXTENDED MALARIA CONTROL PROGRAM

Large numbers of infected servicemen are returning from some of the most highly malarious areas in the world to become potential carriers of malaria in this country. Some authorities estimate that 2,000,000 or more men will return home to introduce foreign, and possibly more dangerous, strains of malaria parasites, threatening to upset the favorable balance which has held malaria at a very low level in recent years. Without some provision to meet this hazard, a decided increase in malaria in the United States may be expected.

The Extended Malaria Control Program has been formulated to prevent this threatened spread of malaria. It proposes an intensive anopheline control campaign in those areas where the disease is now endemic and prompt control through mobile units of any explosive outbreaks which may occur elsewhere.

Returning carriers will be distributed throughout every State in the Union, but they will be of most concern in those localities where present conditions are optimum for transmission of the disease. Since the very existence of endemic malarious areas implies favorable biological conditions for transmission, our first point of attack should be these endemic zones. Under the proposed program, transmission of the disease should be made so difficult that malaria carriers may return without causing an increase in the malaria rate or an enlargement of the endemic areas.

On the other hand, carriers who return to regions outside these endemic areas may

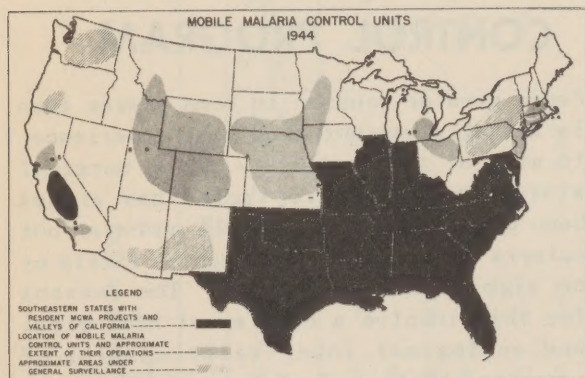
cause greater concern in some states than is actually warranted by past experience. In many of these, the so-called marginal states, the mosquito vector has always been present in considerable numbers, but malaria transmission has been of little or no significance recently. The reasons for this involve a complex of biological and ecological inter-relationships of parasite, host, and vector as well as the development of drainage and a more prosperous economy. In the past, those outbreaks which have occurred have been largely self-limited, and malaria has not persisted to a dangerous degree. If outbreaks should develop in marginal States in spite of these hindrances to transmission, the provisions that have been made for their control will be put in force.

### HISTORY AND DEVELOPMENT

With the outbreak of the present war, enormous numbers of individuals were moved from non-malarious areas of the United States to the malarious South. Millions of men were gathered in southern camps where the climate permitted year round maneuvers during their training period, and thousands of migrant workers moved into the South to work in the expanding war industries. Since mass migration of non-immunes into malarious areas had always produced serious consequences, epidemiologists and public health officials were justly concerned. To prevent expected increases in malaria, the Public Health Service was given the responsibility for directing anti-malaria measures in war areas.



The Malaria Control in War Areas program was organized in March 1942, as a joint undertaking of the several State Health Departments and the Public Health Service. Its primary objective was the control of anopheline mosquito production and the reduction of malaria transmission in extra-cantonment zones of military and essential industrial areas. The program was to complement similar work by the Army and Navy within their respective military reservations.



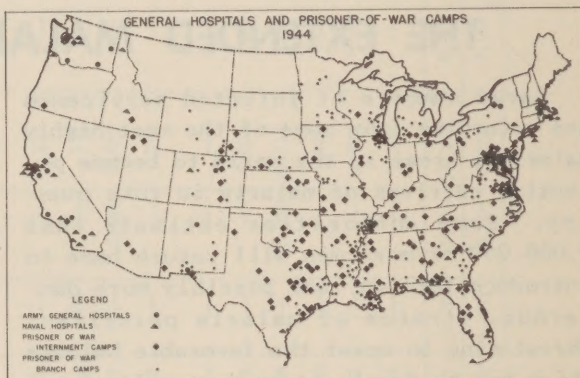
Location of MCWA Activities

That no serious outbreak of malaria has occurred is probably due to a number of factors, not the least of which have been the extensive programs of the Army and Navy within military reservations and that of MCWA outside these areas. The record of the success of these programs is clear. Army malaria admissions per 1000 men in the continental United States were not only much lower than for World War I, but actually decreased from 1941 to 1943. During this same period, malaria continued its downward trend in the civilian population even among non-immunes introduced into malarious war areas, and at the present time is at its lowest point in our history. Thus the original objective of MCWA has been accomplished. Troops and war essential personnel have been protected.

MCWA operations were originally limited to 18 southeastern states, the District of Columbia, the valleys of California and Oregon, and Puerto Rico. In 1942, 900 Army, Navy, and war-connected establishments were protected, and by June 1943, this number had increased to 1,161 in 21 States. At the present time, some 2,000

war establishments are included in the MCWA program.

In 1943, a slight shift in general MCWA policy began with the return of the first malaria cases from overseas. The increased number of hospitalized malaria cases and the first prisoners-of-war being returned to the United States then presented the problem of protecting surrounding civilian populations from concentrated military reservoirs of infection - a reversal of the original objective of the program.



Military Hospitals and P.O.W. Camps

At that time, the Surgeon General of the Army requested the application of intensive malaria control measures in areas adjacent to general hospitals and prisoner-of-war camps. That trend continued in 1944. The number of hospitals and prisoner-of-war camps rapidly increased. Further large numbers of furloughed or discharged men from malarious areas were being scattered throughout the country. It was clear that this mass importation of malaria was rapidly becoming a most important public health problem - one which would increase with total demobilization.

Thus we are now at a critical point in the history of malaria in the United States. The disease has reached an all-time low, but the return of large numbers of carriers will upset this favorable balance if vectors are not controlled. Many of the carriers harbor new strains of malaria for which the native population has little tolerance. It has been estimated that perhaps two or more million men may return with foreign malaria parasites in their blood. Some of these new strains of parasites may be more virulent than those



we now have, and the greater relapse rates of Mediterranean and South Pacific vivax malaria will make these men even more dangerous carriers, since they will be able to infect our local mosquitoes more often.

When this problem of returning malaria carriers first became apparent, a plan to meet this threat was proposed by Dr. L. L. Williams, Jr., then in charge of the MCWA program. This plan was based on the premise that since it is neither practical nor humane to restrict the movements of military carriers, efforts must be concentrated against the mosquito vector. These efforts include reducing the hazard of transmission in all endemic areas and preparing mobile units to take care of possible explosive outbreaks in marginal areas.

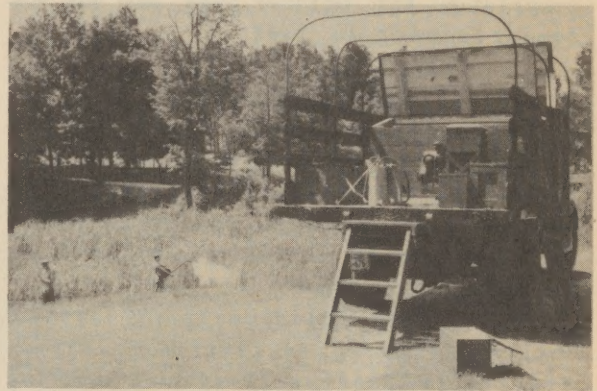
It has been further postulated that this is the strategic time to bring the disease under control. Since the cyclic rise in 1934, malaria rates have fallen so low that there has been no measurable peak, and the endemic areas have been reduced to a minimum by extensive mosquito control operations carried on by the military and by MCWA since the war.

In attacking endemic areas, which are primarily rural and therefore largely outside the scope of former MCWA activities, a great deal of reliance is being placed on the new insecticide, DDT. Used as a residual spray in houses, it is the first weapon available for a wide-spread economical campaign directed specifically against potentially infected mosquitoes in rural areas.

In those endemic areas where extensive anopheline breeding occurs, DDT house residual spraying is the method of choice. 95-98 per cent of the rural areas participating in the Extended Program will be controlled by residual spraying, a much more economical method than larviciding such areas. Where communities of 2,500 or more are included in the Extended Program, larviciding will be used under most conditions since the cost of house spraying in such populated areas would be greater than that of an annual larvicidal program.

DDT residual spraying in houses exercises a selective action in the control of populations of the malaria vector. It re-

sults in the death of those anophelines which have most probably secured a human blood meal and thus concentrates control measures against the potentially infective anophelines in houses. The bulk of mosquitoes remaining in stables and other shelters are of no importance in direct malaria transmission since they will have fed on animal blood in most instances.



**Mobile Unit in Operation**

Outside the endemic areas, possible scattered, explosive epidemics will be controlled by mobile units which can be quickly dispatched to the scene of such an outbreak. These mobile units consist of an entomologist or engineer, a crew, a truck equipped with larvicides, insecticides, and apparatus for their distribution. Production of anophelines will be controlled by larvicidal measures and the danger from already existing adult mosquitoes minimized by an adult spraying program.

With DDT residual spray and a larvicidal program combined in an attack on malarious zones, and the use of mobile units for immediate control of additional localized outbreaks, the hazard of returning carriers and the potential increase in malaria should be effectively prevented. This is the aim of the Extended Malaria Control Program.

The proposed Extended Program was presented for discussion before a meeting of the Association of State and Territorial Health Officers held in New York, October 6, 1944. This group endorsed the proposed program in a formal resolution of the Association and recommended that the Surgeon General of the Public Health Service place the problem and its proposed solu-



tion before the Congress. Military authorities endorsed the proposal.

Accordingly, the U. S. Public Health Service formally presented the program to the Bureau of the Budget in October 1944, and requested an initial appropriation for the Extended Malaria Control Program. This was granted in the First Supplemental Appropriation Act, October 1944, and was approved December 22, 1944.

### GENERAL POLICIES

The administrative pattern of the Extended Program is similar to that established for MCWA. It utilizes established machinery and procedures and the mobilized technical staff. Fiscal arrangements are essentially the same.

Although administration of the Extended Program is similar to other MCWA activities, it is important to realize that the underlying philosophies governing the two are quite different. The regular MCWA program is designed to protect military and war industrial personnel from civilian malaria. The Extended Program, on the other hand, is primarily intended to protect general civilian populations in the most malarious areas from returning military carriers of the disease. Therefore, increased emphasis will be placed upon participation by state and local health agencies.

Basic plans and policies may be summarized as follows:

1. General policy direction within congressional and budgetary mandates will be exercised by the Headquarters Office in Atlanta as for other activities of MCWA.

2. The approved areas for control operations will be determined by the medical epidemiologists of the Headquarters staff in close cooperation with the State Health Departments. Adjustments or changes in the originally selected areas may be made as the developing epidemiological picture may dictate.

3. Direction of project operations by the State Health Departments will be on the basis of approved project proposals. Public Health Service personnel will be

detailed to the State Health Departments for assignment to project operations.

4. Personnel provided under the extended malaria control appropriation bill will be used on larvicidal control and incidental drainage in approved communities and for DDT residual spraying in selected rural areas. In general, labor and materials for permanent drainage are to be provided locally. Technical personnel assigned to State Health Departments may also be used for surveys, development, and technical direction of other justified anti-malarial measures.

5. Pre-service and in-service training facilities developed by the Atlanta office have been expanded and are available to all State Health Departments. These facilities comprise a course in malaria control fundamentals including lectures and field training. Particular attention is given to newly developed techniques of adult mosquito destruction such as the DDT residual sprays.

6. To assure maximum coverage and long range benefits, the proposal includes an educational program aimed at accomplishment of this objective through stimulation of individual and community participation. Further, this educational program should provide needed reassurances to those communities unduly alarmed about the significance of demobilized malaria carriers.

7. In the marginal states, facilities are available for epidemiological surveillance in areas where densities of malaria vectors are of concern. Where malaria transmission is demonstrated, mobile malaria control units will be made available immediately. Eight such units are already organized and strategically located to provide interim control while local facilities are being mobilized. Trained personnel will also be provided on request for a survey of the malaria hazard and for organization of necessary anti-malarial measures.

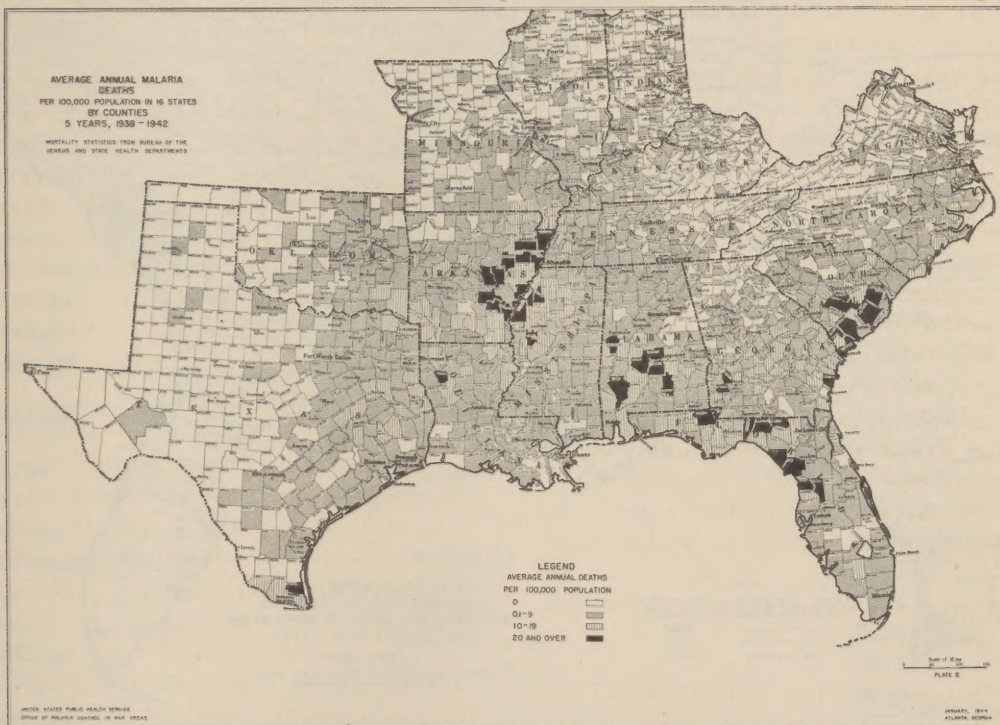


# SELECTION OF EXTENDED PROGRAM CONTROL AREAS



The problem of accurately delineating the areas of most active and intense malaria transmission in this country at the present time is a difficult one. Criteria for reporting and adequacy of notification of cases and deaths vary considerably from locality to locality. The general outlines of these foci, however, are more adequately expressed by charting reported mortality-

deemed necessary on the basis of published data. However, in a period of pressing manpower requirements, it was believed that some adjustment should be made on the basis of deaths in relation to the sizes of specific areas involved. Accordingly, the death rates by population were weighted statistically by death rates per square mile, and counties were ranked in order of the magnitude of these combined rates as shown in the map on the following page.



**Malaria Deaths per 100,000 Population 1938-1942**

ty from the disease than by use of case reports. The average annual death rates per 100,000 population for the years 1938- to 1942 are illustrated in the accompanying map for the counties of the traditionally malarious areas of the Southeast. The zones of heaviest mortality in recent years are believed to be those most in danger of serious and more permanent recrudescence of the disease if the hazard of a large increment of carriers returning with exotic strains of malaria develops its full potentialities.

The map, therefore, shows the general outlines of the area in which work was

Following this preliminary evaluation, conferences were held with malariologists of the various State Departments of Health. Their broad experience, not only with the distribution of the disease in their own States but their intimate knowledge of the vagaries and variables of reporting, supplemented the more general impression gained from mortality statistics. In addition, a more detailed study was made of malarial deaths in minor civil divisions of many counties. An appraisal of all these data led to the initial selection of all or parts of 68 counties in 9 States of the Southeast as representing the areas in

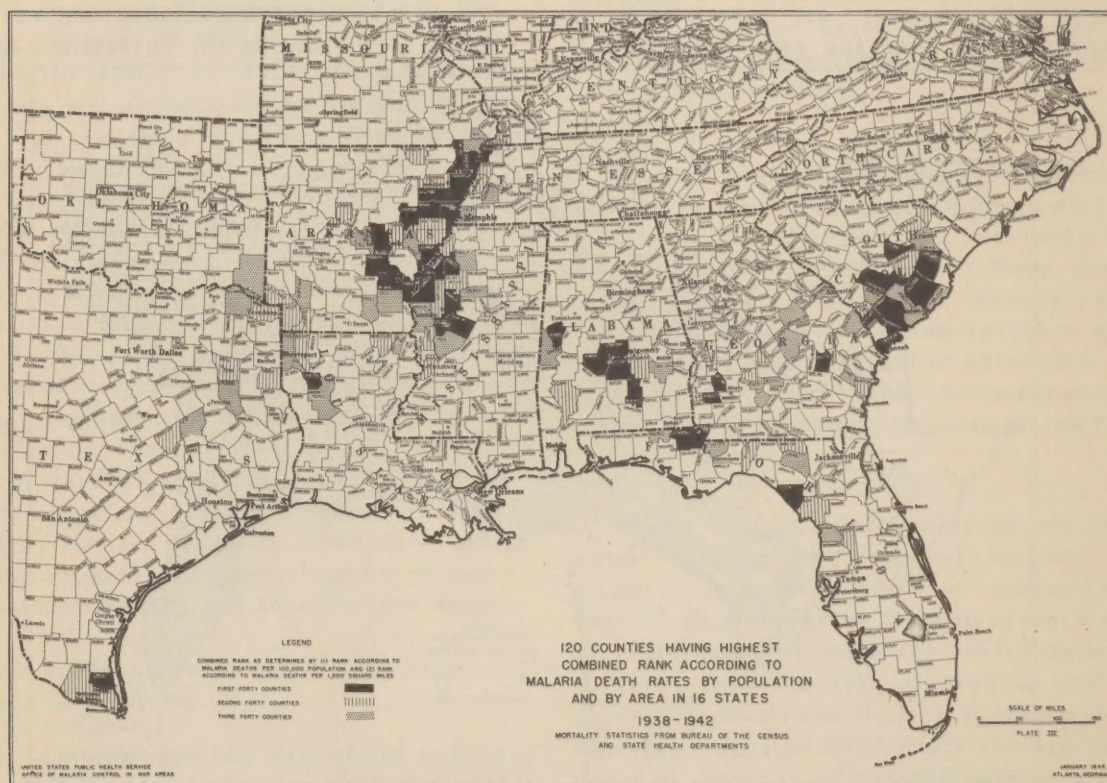


which control operations appeared to be most necessary in the coming year.

Since these 68 counties were first selected, some modifications have been made in the areas to be worked in the original 9 States. Certain changes and additions were made on the basis of the States' desire for reconsideration of the importance of some malaria foci. Other revisions were deemed desirable in the interest of economy of manpower and equipment, and

better and more permanent results would be achieved by establishing local projects under trained personnel in these areas where malaria recently has been transmitted with sporadic frequency. The disease has been of significant importance in such places and, therefore, limited control projects have been approved in these States.

The distribution of all counties in which approved projects will be undertaken is shown on the map on the back cover.



#### Counties Ranking Highest by Combined Population and Area Malaria Death Rates 1938-1942

anticipated availability of manpower which varies from locality to locality. Each of these 9 States has sufficient organizational flexibility to shift control operations to possible unpredictable foci. It is believed that a minimum margin of safety has been reached without unduly adding to various war shortages.

Consideration has been given the possible requirements of 5 other States in the traditionally malarious belt. It was first believed that the needs of these States might be met by the use of mobile units. Further analysis indicated that

For areas outside of the recently endemic zone, but where vectors are prevalent and transmission occasionally occurs, mobile units are being provided for institution of control upon request of the State Health Officer. It is in these regions that we may anticipate the most spectacular effects of the military carriers. On the basis of experience following the Civil and Spanish American Wars, we may expect small, short-term, explosive outbreaks in northern parts of the United States where transmission is now of rare occurrence.



# COUNTIES AND STATES PARTICIPATING IN THE EXTENDED MALARIA CONTROL PROGRAM

JANUARY 31, 1945

## ALABAMA

Autauga  
Dallas  
Greene  
Lowndes  
Marengo  
Montgomery

## ARKANSAS

Crittenden  
Cross  
Desha  
Jefferson  
Lincoln  
Lonoke  
Mississippi  
Phillips  
Poinsett  
Woodruff

## FLORIDA

Citrus  
Dixie  
Jackson  
Jefferson  
Levy  
Leon  
Madison  
Sumter  
Suwannee  
Taylor

## GEORGIA

Calhoun  
Crisp  
Dooly  
Lee  
Sumter  
Terrell  
Worth  
Seminole  
Jenkins  
Burke  
Screven

## LOUISIANA

Bossier  
Caddo  
Madison  
Morehouse  
Natchitoches  
Red River

## MISSISSIPPI

Bolivar  
Coahoma  
Grenada  
Holmes  
Humphreys  
Leflore  
Quitman  
Sharkey  
Sunflower  
Tallahatchie  
Tunica  
Washington  
Yazoo

## MISSOURI

Dunklin  
New Madrid  
Pemiscot

## SOUTH CAROLINA

Beaufort  
Berkeley  
Calhoun  
Charleston  
Clarendon  
Colleton  
Georgetown  
Hampton  
Orangeburg  
Sumter  
Williamsburg  
Jasper

## TEXAS

Bowie  
Cameron  
Hidalgo  
Red River  
Lamar  
Willacy

## KENTUCKY

Fulton  
Graves  
Hickman  
McCracken

## NORTH CAROLINA

Beaufort  
Bladen  
Duplin  
Edgecombe  
Halifax  
Johnston  
Martin  
Northampton  
Person  
Pitt  
Robeson  
Warren  
Wayne

## TENNESSEE

Dyer  
Lake  
Lauderdale  
Shelby  
Tipton

## OKLAHOMA

(Tentative)

McCurtain  
Choctaw  
Pushmatacha  
Bryan  
Marshall



## TYPES OF PROJECTS

Three general types of projects are being approved for operations under the Extended MCWA Program during the fiscal year 1945. These are (1) larvicidal and minor drainage, (2) major drainage, and (3) DDT residual spraying.

Larvicidal and minor drainage projects may be undertaken around urban areas wherever the annual cost of larviciding is lower than, or will not greatly exceed, the cost of residual spraying. Reconnaissance surveys or experience in previous project operations can be used to determine these comparative costs. However, for initial operations during the fiscal year 1945, any urban area may be larvicided provided this method is deemed feasible. This provision is made to offset the shortages of supplies and equipment for DDT residual spraying which are critical at the present time.

For each population group, either antilarval or anti-adult measures will be used, not both. Exceptions to this general rule may be made in emergency situations where current malaria transmission is occurring. In general, larviciding and minor drainage is the method to be used for urban populations, particularly those of over 2,500 population, although there will be numerous exceptions.

Major drainage projects may be proposed under the Extended Program and submitted for approval as prescribed for regular MCWA activities.

Residual spraying to control adult mosquitoes is a new method of general applicability for rural areas, and this method is being used in all the endemic centers not scheduled for protection by antilarval methods. To avoid duplication of protection between antilarval and anti-adult methods, exposure of the human population rather than the terrain will be the criterion.

Project proposals which involve larvicidal and minor drainage or major drainage operations may be submitted according to previously established procedures of MCWA. Since DDT residual spraying is to be used extensively by MCWA for the first time in this program, suggestions and aids in the preparation of cost estimates for residual spraying and field operating procedures have been distributed to the States concerned.

The residual spray project proposals are prepared by the State Health Departments for each operational area where such work is contemplated. These projects are then reviewed by the Headquarters office before work is inaugurated.



Drainage

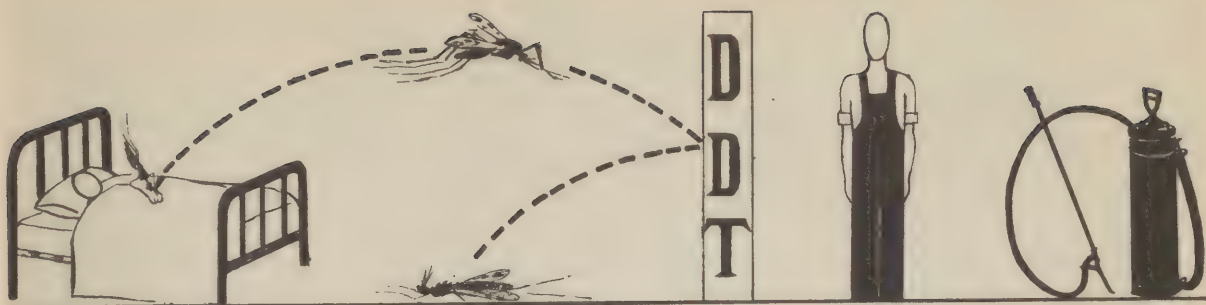


DDT Residual Spraying



Larviciding





## DDT - A NEW WEAPON IN MALARIA CONTROL

When a complete history of the major scientific achievements made during the present war is written, advances in the control of insect-borne diseases will occupy one of the most prominent parts in that account. The most important single advance will most probably concern DDT, one of the newest and most unusual insecticides developed since the start of the present war. Its remarkable ability to kill insects in very minute amounts, its use against such a wide variety of insects, and its prolonged residual effect when sprayed on surfaces may well revolutionize methods in the control of many of our most important insect pests and disease vectors. Its promise in the field of malaria control is so great, that it is to play a major role in the Extended Malaria Control Program.

DDT was first synthesized by Othman Zeidler, a German chemist, in 1874; but its insecticidal properties were not realized until 1939 when Paul Muller reported its effect on flies, clothes moths, and plant lice in Switzerland. In November 1942, the Bureau of Entomology and Plant Quarantine, U.S.D.A., received a sample of the material from J. R. Geigy and Co.

During 1943, the laboratories of the Division of Insects Affecting Man and Animals at Orlando, Florida, began a series of extensive tests to determine the effectiveness of DDT in the control of various insect pests and disease vectors affecting military personnel. Exhaustive field and laboratory investigations were initiated in April 1944 at the Carter Memorial Lab-

oratory at Savannah, Georgia, to develop and test residual spray formulas and application equipment upon which the Extended Program operational procedures are based. Other widespread research programs have been inaugurated by the Tennessee Valley Authority, by the National Institute of Health laboratory at Memphis, Tennessee, by various State Universities and Experiment Stations, and by private laboratories.

### CHEMISTRY OF DDT

Dichloro-diphenyl-trichloroethane, or DDT as it is more familiarly known, is a fine white powder with a tendency to lump in an unadulterated state. It does not deteriorate when exposed to atmosphere and sunlight and does not evaporate. It is insoluble in water, but is soluble to varying extents in different organic solvents. Its physical properties are such that it can be dispersed either in oil solutions, in emulsions, in diluted dusts, in aerosols or in smokes for use as larvicides or adult sprays. Of special importance in malaria control, and particularly in the Extended Program, is the unusual ability of DDT spray deposits to kill insects walking over sprayed surfaces weeks or even months after its initial application.

The details of its physiological effect on insects are not fully understood. Apparently, the DDT is absorbed through the tarsi. Shortly after exposure to DDT, the affected insects drag their legs, their movements become poorly coordinated, and they finally develop tremors and die.





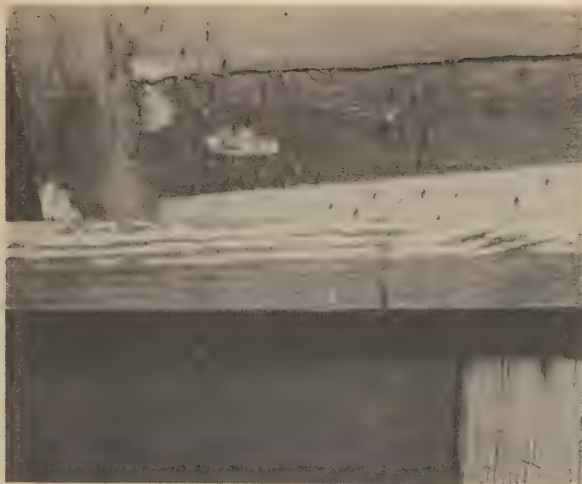
**A Fan-Shaped Spray Acts Like a Brush in Applying DDT**

DDT does not repel insects. Mosquitoes on first entering a treated room rest quietly on the walls and ceilings, but after 5-10 minutes exposure, they become restless and attempt to escape. The first knockdown usually occurs in 8-18 minutes, and is largely complete in 30-90 minutes, except for a few resistant specimens which may remain after 2-5 hours. After irritation begins, specimens move towards the light, and some may escape but usually not before obtaining a lethal dose. This may be important from the public relations standpoint since the average householder may expect to see a large number of dead mosquitoes in the house and thus get an erroneous impression of the success of the spray if they are not found.

The major purpose of using DDT in a residual spray is to form a deposit that will kill insects, which rest on or crawl

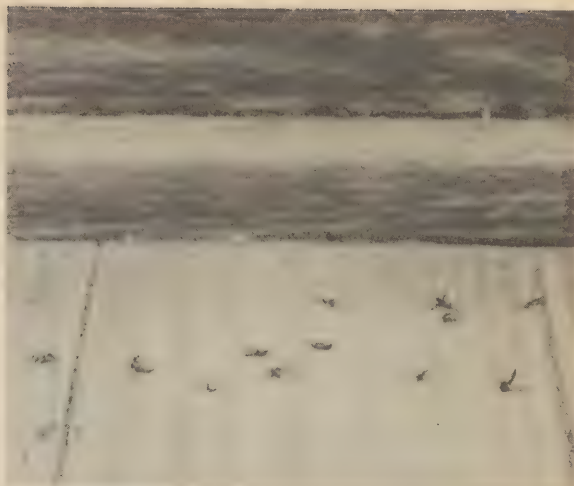
over the treated surfaces for several weeks or months after it is applied. The potentialities of DDT spray residue as a means of controlling mosquitoes, and consequently the diseases they transmit, are almost unlimited. Residual spraying promises to be the most effective method yet known to control those anophelines which are most likely to pick up gametocytes from carriers and to kill these mosquitoes before the cycle of the malaria parasite in the mosquito host can be completed. This latter period may require 12 days, yet a 10-minute exposure to a treated surface at any time during this period will result in the death of these mosquitoes before they can become infective to other individuals living in the house or neighboring community. This is the premise on which the Extended Malaria Control Program through DDT residual spraying in houses is based.





**Anophelines in an Unsprayed Resting Place**

This type of house treatment, while primarily intended for mosquitoes, will also help control other insect pests that enter houses - house flies, cockroaches, bedbugs or "chinchies," ants, fleas, and carpet beetles - although the spraying technique in the Extended Program does not include special consideration of the habits of these pests. If the householder wishes, bedbug infestation can be prevented or controlled by spraying the bedsteads and mattresses with DDT. Since the decrease in anophelines and in malaria



**Anophelines Killed by DDT Residue**

will not be so readily apparent to average householders, the most striking effect of the residual spray to the general public will be the control of house pests, especially flies and cockroaches. These indirect benefits in general sanitation may help in public relations work on the Extended Program, facilitating the aim of malaria control.

#### **AVAILABILITY OF DDT**

At the present time, the Armed Forces are using almost the entire available production of DDT. Except for relatively small amounts used in research and in the Extended Program, most of this production is being sent overseas. The use of DDT in the control of body lice and typhus in the recent Naples epidemic is one of the most remarkable stories of the war, and it is routinely used by our troops wherever typhus is a threat. DDT is being extensively used in the malaria control programs of the Army and Navy in all the theatres where malaria is a problem. The application of DDT as a residual spray to tents and barracks has become a routine procedure in anopheline control overseas, and its use in oil as a larvicide is increasing. When DDT production is sufficiently increased to take care of the enormous overseas demand, we can look forward to a still wider use of the material in the general control of malaria in this country. Until that time, the limited supply will be used only in the residual spray portion of the Extended Program.



**Highly Magnified DDT Crystals**





**DDT Powder**

#### **SAFETY OF DDT AS AN INSECTICIDE**

The Industrial Hygiene Research Laboratory of the National Institute of Health reports that in spite of its inherent toxicity, DDT in the usual insecticidal concentrations in air is of such low toxicity that it will not cause injurious effects in human beings. A clinical and laboratory study of three men who had had several months of continuous occupational exposure to DDT in its various forms as an insecticide failed to indicate any definite toxic



**Remove DDT Oil Solutions from Skin**

effects from exposure to the material. However, massive doses, such as a teaspoonful taken by mouth by the average sized man, or constant and excessive exposure of the skin to solutions of DDT in oil may cause toxic reactions. Consequently, contamination of foods should be avoided; clothes soaked with DDT in oil should be removed immediately after work, and the skin should be washed with soap to prevent excessive absorption. A respirator should be worn as an added precaution when applying a fine spray in a closed room. In general, the usual well-known precautions taken with any insecticide should be followed in handling DDT.



**Wear Goggles and Respirator**

To date, no case of typical DDT poisoning has been observed in human beings. Reports of dizziness after spraying all day and complaints of skin rash are typical of kerosene or xylene exposure. The routine use of respirators and goggles and the avoidance of excess skin contact should minimize these effects. However, all toxic reactions due to spraying on the Extended Program should be referred to a physician immediately. If true DDT poisoning is suspected, a full report should be submitted, through the Officer in Charge, M.C.W.A., to Dr. Paul A. Neal, Chief of the Industrial Hygiene Laboratory, National Institute of Health, Bethesda, Maryland.



## RESIDUAL SPRAYING PROCEDURES



Treating a Room with DDT Residual Spray

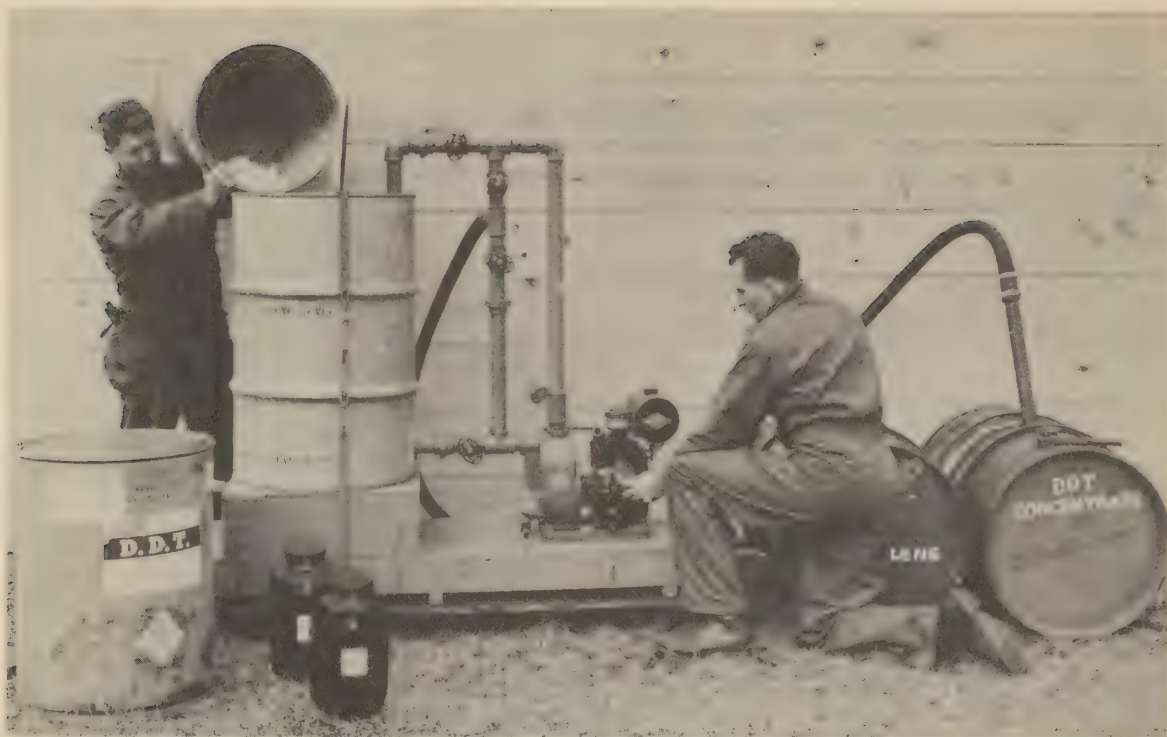
A considerable amount of research has been carried out at the Carter Memorial Laboratory in devising formulas for spray concentrates and mixtures, in fabricating special equipment for field application of DDT sprays, and in determining efficient operational procedures to be used in the Extended Program.

Some of the early residual spray work utilized kerosene as a solvent for DDT, but the danger of staining walls and fabrics and the small quantities of DDT soluble in kerosene made another solvent desirable. Xylene appears to be the best available material since it dissolves relatively large quantities of DDT, is readily emulsified, and is fairly cheap. Triton X-100 has been selected as the emulsifier. Several formulas for DDT-xylene-Triton emulsion concentrate have been developed containing different percentages of DDT. A special effort has been made to evolve formulas and mixing procedures requiring a minimum of time and equipment, so that spraying procedures in the field will be facilitated.

### PREPARATION OF THE EMULSION CONCENTRATE

Because of the need for care and accuracy, it is desirable to install one or more central mixing plants in each State to prepare the emulsion concentrate for distribution to the various projects. This prepared concentrate can then be readily diluted with water at the spraying site at the time of treatment. These central mixing plants provide a greater standardization of mixing procedures, insure proper solution strength, reduce industrial and occupational hazards, help in the utilization of labor saving practices and equipment, conserve DDT, require the training of fewer persons in mixing procedures, and improve the dispatching and rationing of DDT to projects. This latter is of particular importance during the 1945 season, since the 100 tons of DDT available to MCWA for the Extended Program will be supplied in small quantities throughout the entire year and not in a single large shipment. This is due to the great demand on current DDT production by the Armed Forces overseas.





**Mixing DDT Emulsion Concentrate with Power Equipment**

#### **MIXING DDT EMULSION CONCENTRATE**

Presumably the central mixing plants will be located at the central MCWA warehouse in each State, at the central or district mechanical repair facility, or at an area Headquarters. Location at the central warehouse will permit savings in labor and supervision and facilitate the joint delivery of supplies, materials, and equipment to projects by the supply truck. In some States, the central warehouse may be remote from the center of Extended Program operations and hence may not be satisfactory. In other cases, lack of space may dictate selection of a different site for the mixing plant.

Central mixing plants are assembled at Savannah for shipment to States. Power driven and hand operated mixers are available, but accessory equipment will depend on whether operations are to be carried on in an enclosed building or in a yard or open shed. The types of mixing plant units available are as follows:

**Type A** - A power mixing plant assembly with appurtenant items including an industrial type fire extinguisher, small platform

scales, chemical fume respirators, neoprene gloves, etc.

**Type B** - Type A plus an 18 inch electric exhaust fan for wall mounting - a power mixing plant for enclosed buildings.

**Type C** - A hand mixing plant assembly with appurtenant items.

**Type D** - Type C plus an 18 inch electric exhaust fan for wall mounting - a hand mixing plant for enclosed buildings.

#### **POWER MIXING PLANTS**

Power mixing plants are available for those States which have an estimated annual consumption of 10,000 pounds of DDT or more. Hand mixing plants are recommended where the estimated annual consumption is less than 10,000 pounds, assuming one pound of DDT per house per year. Operation of mixing plants in the open is recommended whenever possible. Ventilating fans are necessary wherever circumstances dictate mixing the emulsion concentrate in an enclosed building.

The power mixer shown in the photograph was developed at the Carter Memorial Laboratory. It consists of an upright 55



gallon steel drum and gasoline engine-pump assembly mounted in a fixed position on a wooden hand barrow platform. When the drum is empty, the entire unit can be lifted and carried short distances by two men and can be hauled in a truck. Valves and piping are arranged to permit (1) pumping of xylene into the mixing drum from a 55 gallon steel xylene drum at ground level, (2) recirculation of the DDT-xylene-Triton mixture through the pump for mixing purposes, and (3) delivery of the mixed concentrate from the mixing drum into 55 gallon drums for storage or shipping. Smaller containers such as 5 gallon Army type steel water and gasoline cans can be filled from a petcock at the base of the mixing drum. Drainage and flushing of the entire assembly is also possible through the same opening.

Special formulas have been devised and the amounts so calculated that they can be measured into a power unit with a minimum of effort. Winter and summer formulas, containing about 35% and 20% DDT respectively, have been developed since xylene does not readily dissolve the larger percentage of DDT at lower temperatures (60° F. and below). But in most operations, the summer formula will be routinely used, since the major part of the spraying program will be carried on during warmer weather.

	Summer Formula	Winter Formula
DDT	125 lbs.	70 lbs.
Xylene	31.5 gals.	35 gals.
Triton	2 gals.	7 qts.

Addition of 13 parts of water to 1 part of summer concentrate, or 7 parts to 1 part of winter concentrate, results in a standard 2½% DDT spray containing 25 mg. of DDT per cc. of spray solution.

The power mixers are designed to mix 125 pounds of DDT in each operation. The approximate time for dissolving the DDT in xylene and mixing with Triton is 5-10 minutes and for the entire operating cycle, 15 minutes. With this assembly, 500 pounds of DDT or about 168 gallons of the 35% summer concentrate can be mixed in an hour - enough to spray over a thousand homes when diluted to the standard 2½% spray.

## HAND MIXING PLANTS

Several types of hand mixers have been developed for use in States with smaller programs. These are of all-wood construction and mainly resemble butter churns. The simplest and most usable type consists of a 55 gallon wooden barrel mounted on rockers as shown in the photograph.



Preparing Concentrate with Hand Mixer

Materials are added through a large bung-hole on the upper side of the barrel, and the mixture is agitated by rocking the barrel back and forth. Quantities suitable for this hand operated mixer are given below.

	Summer Formula	Winter Formula
DDT	84 lbs.	44 lbs.
Xylene	21 gals.	22 gals.
Triton	5¼ qts.	4½ qts.

This results in a 35% and 20% DDT concentrate which can be diluted as described above to make the standard 2½% spray.

## MIXING THE SPRAY SOLUTION

For field operations, the DDT concentrate is carried to the project site in oil drums or in 5 gallon cans, depending upon the extent of operations. Hand sprayers of the Hudson industrial type having a four gallon capacity will be commonly used. One pint of the summer concentrate is placed in the tank and 13 pints of water added. Marking the proper level in the sprayer will avoid the necessity for measuring out 13 pints of water



each time the tank is refilled. After the cover is replaced, the tank is inverted several times to insure thorough mixing; the air pressure is brought up to approximately 50 pounds by 60 strokes of the air pump, and the spray emulsion is ready for application. The smaller Hudson Climax Junior hand sprayer has a capacity of  $2\frac{1}{2}$  gallons. One-half pint of concentrate plus  $6\frac{1}{2}$  pints of water will give the proper spray and 45 strokes will give a correct operating pressure of 50 lbs.



**Preparing DDT Spray**

In diluting the concentrate for use in a power sprayer,  $3\frac{1}{2}$  gallons of the summer emulsion concentrate are placed within the tank and  $45\frac{1}{2}$  gallons of water added. These amounts are calculated to fill the tank, and in actual practice it will not be necessary to measure the water in gallons. The pump is started, and once the pressure reaches 60 lbs., spray operations can proceed as with the hand sprayers.

Temperature will determine the use of summer or winter concentrates in preparing the spray solutions. If under  $60^{\circ}$  F., the winter formula will be used, but this will probably be necessary only occasionally and then only very early in the season.

#### **SPRAYING TECHNIQUE**

Spraying technique used in the Extended Program will be the same whether hand sprayers or power sprayers are used. A

standard dosage of 100 milligrams of DDT per square foot is being recommended for fiscal year 1945 operations. 100 mg. of DDT are included in each 4 cc. of the  $2\frac{1}{4}\%$  spray solution.

Since it is impractical to use measured quantities per unit of surface under field conditions, crews will be trained to spray at a specified time-rate. The nozzles used are calibrated to discharge 757 cc. (0.2 gal.) per minute at 40 lbs. pressure, spraying 190 square feet per minute to give the standard dosage of 100 mg. DDT per square foot. Spraying crews will be trained by repeated practice to automatically spray at that rate thus insuring a uniform coverage of 100 mg. of DDT, or 4 cc. of  $2\frac{1}{4}\%$  spray per square foot of treated surface.

Nozzle No. 1/4 T8002 of the Spraying Systems Company of Chicago, Illinois, is designed for this discharge rate under the proper operating pressure. This nozzle gives a fan spray width of  $80^{\circ}$ ; and when held 18 inches from the wall, gives a swath width of 24-30 inches. Such a flat, fan-shaped spray acts like a brush, cover-



**Spraying 190 Square Feet per Minute**

ing the wall evenly and requiring a minimum of movement on the part of the operator. Spraying is done in swaths from floor to ceiling with the operator facing the wall. He steps sideways the width of the swath after its completion and continues in this manner. The ceiling is spray-

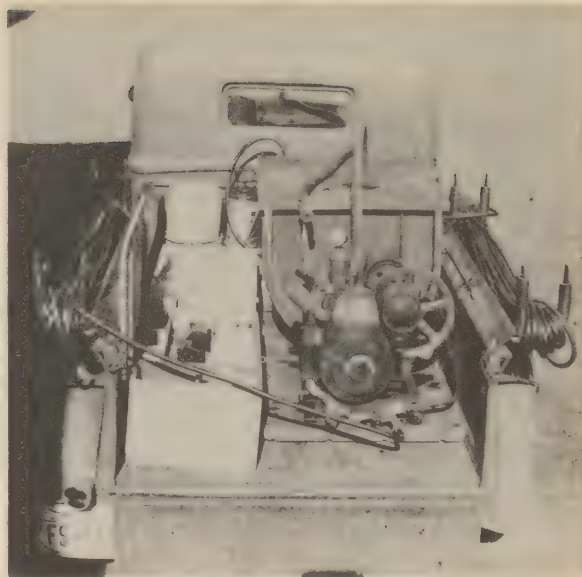


ed in the same way, care being taken to keep the nozzle well away from the operator's face in order to minimize the amount of spray that will fall on him.

Rough wood, paper, beaverboard, plaster board and ordinary wood surfaces will retain 4 cc. of spray per square foot with little or no run-off, providing the spray is applied correctly. Smooth painted surfaces and impervious wall materials require considerable care in application, and even then some run-off may occur when 4 cc. per sq. ft. are used. Such surfaces will probably not be encountered very commonly in this program, but if difficulty is experienced, the spray solution can be increased to 5% DDT and the spraying rate reduced to 95 square feet per minute, thus requiring only 2 cc. per sq. ft. to apply the standard 100 mg. In lieu of this, a 1/4 T8001 nozzle having half the discharge capacity of No. 8002 can be used with 5% DDT without changing the spraying rate.

In rural areas where houses are separated by some distance, hand sprayers will be most suitable in applying the DDT spray. When provided with xylene-resistant hose and gaskets and equipped with the proper nozzle, the Hudson Industrial and Climax Junior hand pressure sprayers are satisfactory. In using these hand sprayers, the air pressure will decrease as spraying proceeds. The pressure in the Hudson Industrial sprayer can be maintained at the required average of 40 lbs. by pumping 30 additional strokes after the first 4 minutes of spraying and then continuing until the tank is empty. With the Hudson Climax Junior model, 18 additional strokes after the first 2 minutes of spraying will increase the pressure to the required amount to finish spraying.

Power sprayers can be used in suburban areas where a large number of houses closely spaced makes possible the spraying of two houses or two rooms simultaneously. Small orchard-type power sprayers have been found adequate for this work. The most useful of these power sprayers have a 50 gallon capacity, a constant pressure regulator, and are fitted with two 100 ft.



**Power Spraying Unit**

lengths of xylene-resistant hose. The same spray nozzle will be used, but since the optimum operating pressure for these units is 60 lbs., the time rate should be increased about 20% if this pressure is used. In power spraying, 227 square feet per minute must be covered to give the standard 100 mg. DDT, because of this increased operating pressure.

#### **COOPERATION OF THE HOUSEHOLDER**

A number of problems are encountered in actual house spraying, especially when the houses are so crowded with furniture and other materials that it is difficult to spray. House owners will be contacted be-



**Enlisting Home Cooperation**





**Cover Varnished Furniture**

fore the beginning of spraying operations and can be notified in advance as to just when the crew will be in their neighborhood. A general educational program is planned, and through public meetings and individual contacts, the purpose and expected results of the work will be explained. Householders should be contacted on the day spraying is to be done, so that they can prepare their houses for treatment. This will greatly decrease the spraying time and increase the efficiency of the work. The actual spraying requires only a fraction of the total time involved in the day's operations, and if people are induced to prepare their houses properly, the en-



**Protect Food and Dishes from the Spray**

tire operational procedure can be facilitated. If houses are not prepared in advance, the time spent in spraying each house is increased at least 4 times.

All varnished furniture to be protected from the spray will be placed in the center of the room and covered with a cloth carried by the crew. Exposed food, dishes, and good clothing should be removed from the house or otherwise protected. A white deposit on dark surfaces and varnished floors can be prevented by using newspapers or cover cloths. Pictures and mirrors should be taken off the walls, and all fires extinguished. Baby beds, children's toys, and exposed cooking utensils should never be treated. Every room in the house will be sprayed including closets, porches, screen or unscreened, and the porch and door screens themselves. The privy will also be treated. The spray will dry in about a half hour, but if surfaces are touched before the spray deposit has dried, streaks may result. The furniture should be replaced by the occupants except for heavy pieces which may require the assistance of the crew.



**Extinguish Fires in Rooms to be Treated**

#### **SPRAYING PRECAUTIONS**

Proper precautions should be taken by the crew in conducting spraying operations. A respirator and goggles should be worn to avoid inhaling xylene fumes and to prevent eye irritation. A wide-brimmed hat and clothing to protect arms and shoulders should be required. If the operators do not wear gloves, they should wash their hands and arms in strong soap solution frequently. Clean rags should be provided to wipe off any spray that may collect on the face. Clothing should be changed every day



so that it will not become saturated with the spray. Greaseless skin lotions may be used to prevent skin irritation due to xylene.

### THE SPRAYING CREW



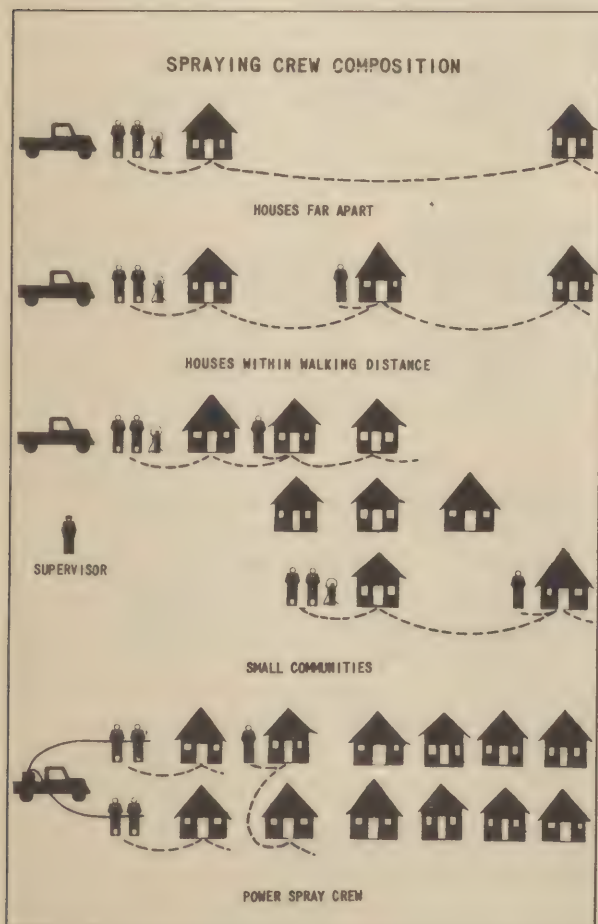
The composition of the spraying crews will vary depending on the population density of the area and upon the promotional methods used. Most hand spraying crews will probably consist of 2-3 men. In areas where the houses are near enough, one man can be sent ahead to contact the householder just prior to spraying while the actual spraying can be done by two men. Where the houses are too far apart for this, a two man crew will probably be most economical and will combine contact work with actual spraying. In hand spraying



### Spraying Crew in Action

small communities, several 3-man crews under one supervisor may be used. Power spraying crews will probably consist of 4-5 men, one for contact work where possible, the others for actual spraying procedures.

Men selected for residual spraying work will require aptitudes different than those necessary in larviciding crews. This is especially important where spraying crew personnel must also do contact work. Men who understand the purposes of the program and who can obtain the cooperation of local people are especially desirable.



### MAPPING RESIDUAL SPRAY AREAS

Where spraying operations are carried on over large areas, the work will be so widespread that it cannot be directed orally. Hence some simple method of graphically indicating sprayed houses is necessary. Actual identification of houses is needed for the work of the spraying crews and for the inspection necessary in the entomological evaluation of the program. County-wide maps, properly prepared, will eliminate the necessity for keeping a separate system of records. Although the houses will be numbered and properly located on maps, the type of map is optional and details in its production and choice of symbols used will vary in the different states concerned.



# DDT RESIDUAL SPRAY FORMULAS AND APPLICATION



EMULSION CONCENTRATE

	SUMMER FORMULA 35% DDT *		WINTER FORMULA 20% DDT *	
	POWER MIXER	HAND MIXER	POWER MIXER	HAND MIXER
DDT	125 LBS.	84 LBS.	70 LBS.	44 LBS.
XYLENE	31.5 GALS.	21 GALS.	35 GALS.	22 GALS.
TRITON	2 GALS.	5 $\frac{1}{4}$ QTS.	7 QTS.	4 $\frac{1}{2}$ QTS.



SPRAY MIXTURE

1 PART SUMMER CONCENTRATE

+  
13 PARTS OF WATER

=

2 $\frac{1}{2}$ % DDT SPRAY \*

CONTAINING 25 MG. DDT PER CC. SPRAY SOLUTION

1 PART WINTER CONCENTRATE

+  
7 PARTS OF WATER

=



100 MG. DDT PER SQUARE FOOT

OR

4 CC. 2 $\frac{1}{2}$ % DDT SPRAY PER SQUARE FOOT

THIS DOSAGE, APPLIED TO WALLS AND CEILINGS, EFFECTIVE 3-5 MONTHS

DOSAGE



NOZZLE NO.  $\frac{1}{4}$ T 8002

80° FAN-SHAPED SPRAY DISCHARGED AT 0.2 GALLONS

OR 757 CC. PER MINUTE AT 40 LBS. PRESSURE.

TO APPLY 4 CC. OF SPRAY AT 100 MG. OF DDT PER SQUARE FOOT, SPRAY AT THE RATE OF 190 SQUARE FEET PER MINUTE.

RATE OF APPLICATION



ONE HOUSE - 1700 SQUARE FEET OF SPRAYED SURFACE - WILL REQUIRE  
AT 100 MG./SQ. FT.

170,000 MG.

OR 170 GRAMS

OR 6 OUNCES OF DDT

1 PINT

OF

SUMMER CONCENTRATE

AT 4 CC./SQ. FT.

6800 CC.

OR 1.79 GALLONS

2 $\frac{1}{2}$ % DDT SPRAY

QUANTITIES PER HOUSE



LABOR

0.8 MAN-HOURS PER AVERAGE TENANT HOUSE  
WITH HOUSE PREPARED FOR SPRAYING.

\* Expressed in per cent for simplicity



# ENTOMOLOGICAL EVALUATION



The real accomplishment of a malaria control program can only be measured by the actual decrease brought about in malaria incidence.

However, when malaria rates are very low, it becomes difficult to evaluate control operations by this means. This problem was recognized early in the organization of the original MCWA program. Since the control measures used in the program are aimed at a reduction of mosquito vectors, an evaluation of results of this work can be made in terms of decreased vector densities. Such decreased densities may be used as a measure of the extent to which potential malaria transmission has been reduced.

In the Extended Program, the idea of anopheline species control of malaria has been still further restricted and is focused directly on destroying those anophelines of the vector species concerned in actual malaria transmission. These are the individuals which enter houses and are most likely to bite infected humans and thereby pick up malaria parasites. Thus general species control has been replaced by "most potential" vector control in the residual spray program. This shift in emphasis will require some revisions in certain parts of the entomological inspection service, now an integral part of regular MCWA activities.

Where the control methods to be used are drainage and/or larviciding, the entomological procedures for dividing the area into zones, for inspecting adult resting places to obtain an index of anopheline abundance, and for reporting results will follow those for regular MCWA operations.

Since DDT residual spray is an innovation in anopheline control, a revised inspection procedure has been developed for this part of the Extended Program. This procedure is based on the fact that DDT residual spraying destroys potentially infective mosquitoes in houses and does not necessarily reduce the total anopheline population to any significant extent. The

general plan consists of two parts - (1) monthly mosquito surveys, and (2) precipitin tests.

## MOSQUITO SURVEYS

Monthly surveys will be made throughout the treated areas to determine the effect of the spray in keeping house interiors free from mosquitoes. At the same time, an index of the actual presence and relative abundance of anophelines in the area will be obtained by counting the numbers in adjacent unsprayed resting places.

In making these adult mosquito inspections, the size of an area and the density of houses will govern the amount of inspection work in each residual spray area. To approximate the number of houses to be inspected, sprayed areas will be divided into sections of about equal house density. In general, 2% of the houses will be inspected each month in those sections averaging less than 8 houses per square mile.



Inspecting House for Mosquitoes

In the more heavily populated areas, 1% will be examined in sections averaging 8-15 houses per square mile, and  $\frac{1}{4}\%$  where the house density is greater than 15 per square mile. Each time a house is inspected, an adjacent unsprayed natural resting place will also be examined to determine the abundance of anophelines at that site. The finding of very few or no mosquitoes in



sprayed houses when anophelines are abundant in nearby natural resting places will indicate the effectiveness of the residual spraying program.

Houses will be chosen for inspection which are near anopheline breeding places and are of such construction as to allow easy access of mosquitoes. The houses to be inspected will be selected at random each month so that information will be secured on the effectiveness of treatments of different ages and on the work of each operating crew. Operational plans provide for spraying at approximately three month intervals, and inspections will be made each month.

Routine inspections need not be made until a significant number of adult mosquitoes begin to appear in unsprayed resting places. After that time, monthly inspections will be made. If possible, all inspections within an area will be carried out within a single week of each month so that collections can be made under comparable conditions. This method will give a composite picture of the effects of the spray over the entire area after different lengths of time rather than data from any specific house location.

In making inspections of sprayed houses, sleeping rooms will be carefully examined for adult mosquitoes, care being taken to examine all furniture, hanging clothes, pictures, walls, and dark corners. If live adult mosquitoes are found during a morning inspection, they will be left undisturbed and an afternoon re-inspection will be made. This will allow sufficient time for the DDT to act on those mosquitoes which may have entered the house during the early morning hours. Results of these inspections - numbers of anophelines in houses and their abundance in unsprayed resting places - will be reported on Form M-4, the summary sheet of adult mosquito collections regularly used in MCWA activities.

#### PRECIPITIN TESTS

The second part of the entomological evaluation of results of the Extended Program is based on the differences in percentages of mosquitoes containing human blood in sprayed and unsprayed areas. This

will be determined by studying their blood meal sources using the precipitin test technique.

In collecting material for these host preference studies, blood-filled anophelines will be taken from natural resting places, prepared properly and mailed to the Carter Memorial Laboratory, Savannah, Georgia. A large sample of engorged mosquitoes is especially needed for this part of the entomological evaluation, and several places should be carefully searched if mosquitoes prove hard to find.



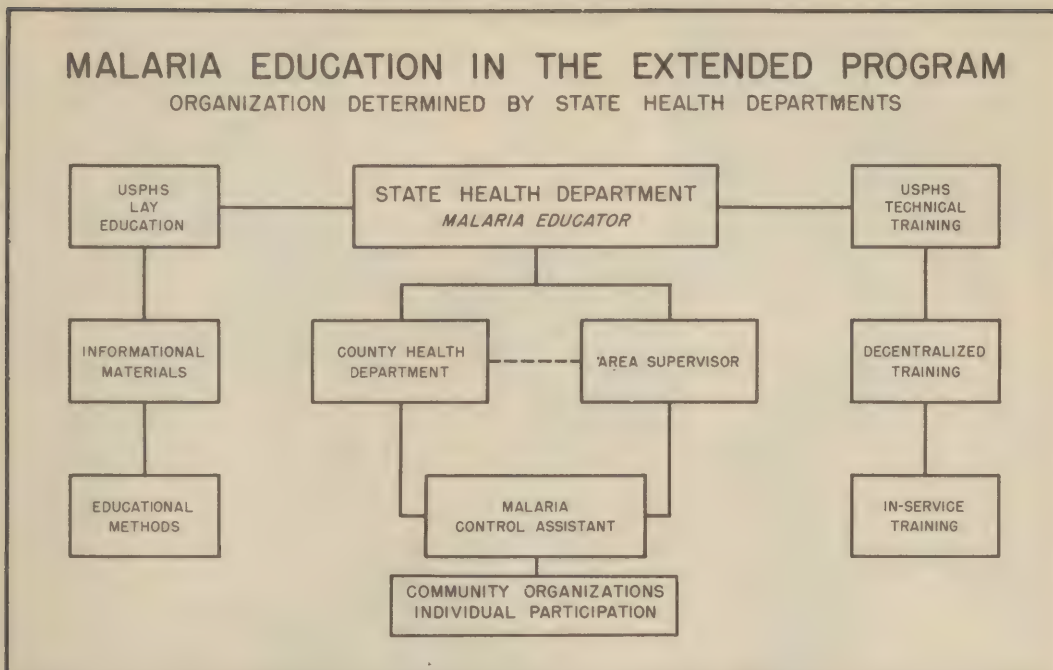
#### Precipitin Test Technique

The precipitin test procedure is essentially as follows. The blood sample is removed from the filter paper on which it was originally collected by soaking in saline solution. This resulting saline-blood mixture (antigen) is then brought in contact with prepared human, equine, bovine, porcine, and avian antisera in five capillary tubes. In the appropriate tube, a precipitate appearing at the point of contact between antigen and antiserum will indicate the source of the blood meal.

A summary of results available from last year's precipitin studies indicates that normally between 3 and 4 per cent of *quadrifasciatus* blood meals are taken from human hosts. Since the residual spray program should accomplish the destruction of the majority of those mosquitoes which enter houses to bite, a significant reduction in this percentage should occur in sprayed localities. Measurements of this reduction will provide an index to the efficiency of the work in decreasing potential malaria transmission - the major aim of the Extended Program.



# INFORMATIONAL SERVICES



A well planned, comprehensive educational program is essential to the success of any proposal involving intelligent co-operation of the public. In the past, most MCWA activities have been concerned primarily with the protection of military personnel. Hence, general education of the public in malaria prevention has been considered of secondary importance in MCWA activities. Since the Extended Program will involve a definite shift to civilian protection, lay education now becomes a line of primary attack.

## LAY EDUCATION

An educational program is necessary for instruction of new personnel in the purposes and techniques of Extended Control, particularly since DDT house spraying is new and has not previously had wide field application in civilian populations. A broad program of lay education is also important for insuring the permanence of the benefits attained and for stimulating community and individual participation in those activities now being sponsored by State and Federal agencies.

The most immediate concern of the informational services in the Extended Program is facilitation of field operations, particularly DDT residual spraying. Since this portion of the program will directly involve cooperation of the people, it is essential to acquaint them with the purposes of the DDT spray and to enlist their help in operations. This immediate function should be a part of a broader malaria educational program and should be coordinated with general health education.

State Departments of Health will continue malaria educational activities in their respective States. Under the Extended Program, these activities will be facilitated through the services of the Division of Training and Education of the Headquarters Office. Services offered by this Division will include training of State personnel, providing consultation service, equipment and materials. Materials to be provided will include motion pictures, film strips, handbills, posters, news releases, briefs of speeches, radio scripts and transcriptions. Educational activities of the Headquarters Office are coordinated with the general health education program of the Central Office.





**Malaria Control Assistant Conducting A Group Meeting**

Nation-wide informational services are being developed by the Division of Public Health Methods of the Public Health Service. These are to include press releases, magazine articles and radio network programs. In order to integrate the malaria educational activities within each State, supervisory personnel at the State level will be desirable. A short training course for such personnel covering the technical phases of malaria control as well as educational techniques is being offered at the MCWA Headquarters Office.

#### **MALARIA CONTROL ASSISTANTS**



"Malaria control assistants", the public relations workers at the local level within the State, will function to facilitate field operations. This will be done through home contacts and through group and community public health education activities. These assistants will be responsible for explaining the purpose, methods of operation and expected results of the Extended Program - especially with respect to residual spraying. The method of approach will vary in different

communities but all will work in close cooperation with local health officers.



In the field, the malaria control assistants will expedite operations by acting as advance contact agents for residual spraying crews. In carrying out the broader aspects of the educational program, they will be responsible for contacting community leaders, arranging and assisting in public meetings, providing approved news releases to local papers, spot announcements and transcriptions to local radio stations, and distributing posters and other malaria educational materials. The malaria control assistant will also handle complaints and inquiries and assist in other phases of public relations work.

Training will be provided for the malaria control assistants by the State Offices. The MCWA Headquarters Office will assist in this training by supplying personnel and materials whenever requested



# ACTIVITIES OF THE MALARIA CONTROL ASSISTANT

## MALARIA CONTROL ASSISTANT

### LOCAL ORGANIZATIONS

Boards of Education  
Parent-Teacher Associations  
Schoolmasters' Clubs  
Chambers of Commerce  
Junior Chambers of Commerce  
Veterans of Foreign Wars  
Lodges and Fraternities  
County Welfare Boards  
Farm Cooperatives  
Future Farmers of America  
Home Demonstration Clubs  
Rural Electrification  
Cooperatives  
Country Store Gatherings  
Court House Gatherings  
Federated Women's Clubs  
Medical Societies

Churches  
Salvation Army  
American Legion  
Red Cross  
Schools  
4-H Clubs  
Boy Scouts  
Kiwanis  
Lions  
Rotary  
Civitan  
Grange  
County Fairs  
Stock Sales  
Home Gatherings  
Girl Scouts  
Farm Bureau

### LOCAL LEADERS

Doctors  
County Nurses  
County Sanitarians  
School Superintendents  
Teachers  
Preachers  
Deacons  
Home Demonstration Agents  
County Agricultural Agents  
Judges  
Rural Mail Carriers  
Country Storekeepers  
Postmasters  
Constables  
Insurance Adjustment Agents

### GROUP ACTIVITIES

Organize Local Meetings  
Sponsor Control Projects  
Sponsor and Conduct Surveys  
Provide Funds for  
Community Work  
Disseminate Information  
Encourage Leaders  
and Organizations  
Carry out Community Programs

### INDIVIDUAL ACTIVITIES

Mosquito-proof Dwellings  
Maintain Improvements  
Spray Mosquitoes in Houses  
Use Netting  
over Malaria Patients  
Stay inside Dwellings  
after Dark  
Wear Protective Clothing  
Consult Doctor for Treatment

Eliminate Mosquito  
Breeding Places  
Prevent Formation  
of Breeding Places  
Use Larvicides  
Cooperate in Community Efforts  
Prepare House for DDT Spraying  
Pass on Information  
to Neighbors

### MATERIALS

National News Releases  
Local News Releases  
Magazine Features  
Network Radio Programs  
Local Radio Spots  
Radio Scripts

Film Strips  
Cartoon Strips  
Newspaper Mats  
Movies  
Premise Folders  
Posters

Supervisor's Manuals  
Malaria Control Pamphlets  
Handbills  
Photographs  
Speech Briefs  
Exhibits



### DECENTRALIZED TECHNICAL TRAINING

Under the sponsorship of the Training and Education Division with an instructional staff provided by the Carter Memorial Laboratory, a series of three courses have been offered on the techniques of mixing and application of DDT. In these courses, key personnel from State and District Offices have received instructions, through lectures, discussions, filmstrips, demonstrations and field participation in the techniques of DDT residual spraying.



In-Service Training Class in Session

Training of supervisors and crew members will be continued in the States by those who have received training in the Headquarters training course. Materials and instructors with field experience in DDT residual spraying are available to assist the States in this training. Field manuals and other reference materials are also being provided for use by operational personnel.

### PRE-SERVICE TRAINING



Pre-service training will be offered all new supervisory personnel recruited for the Extended Program. This course will be given in the Headquarters Office and will be designed to give a comprehensive view of the malaria problem, including disease-vector relationships, logical approaches to malaria control and the roles of medical, entomological and engineering sciences in mala-

ria prevention. Illustrated lectures, motion pictures, film strips, discussions, supplemental readings, laboratory and field work will provide the training experiences.

### PROFESSIONAL MALARIA EDUCATION

While the major part of malaria educational activities will be directed toward those in greatest danger of contracting the disease, a definite effort will be made to reach professional groups and special lay groups whose activities relate

to malaria control. The present program includes plans to reach engineers concerned with drainage construction of highways and with various types of impoundments so that malaria preventive measures will be incorporated in plans for construction and maintenance.

Special work with medical societies will be undertaken to stimulate improvements in techniques of malaria diagnosis and better case reporting.

Educational activities with colleges and universities, graduate and medical schools, will be aimed at increasing attention to the parasitological, entomological, and other biological phases of malaria. Steps have already been taken to stimulate increased teaching of the principles and practices of malaria prevention in general engineering courses. In all contacts with educational institutions, the importance of the practical field aspects of the problem will be stressed.

# IN-SERVICE TRAINING AND ORIENTATION COURSE

## MALARIA CONTROL

### ENTOMOLOGY

Mosquito Identification  
Anopheline Habits  
Station Establishment  
and Inspection  
Interpretation  
of Data

### ENGINEERING

Surveys  
Mapping  
Larviciding  
Drainage  
Residual Spraying  
Other Control Methods

### MEDICINE

Epidemiology  
Life Cycle  
of Parasites  
Microscopic and  
Clinical Diagnosis  
Treatment

### ADMINISTRATION

Payroll  
Personnel  
Procurement  
and Supplies  
Property Records  
Travel Vouchers

### FIELD PRACTICE

Surveys  
Mapping  
Larviciding and Drainage  
Residual Spraying  
Entomological Inspection  
Progress Reports

### EXTENDED PROGRAM

Scope  
Mapping  
Larviciding and Drainage  
Residual Spraying  
Entomological Inspection  
Progress Reports

### ORIENTATION

Public Health Service  
State Health Departments  
Local and County  
Health Departments  
Lay and Professional Groups

### DENGUE & YELLOW FEVER

Aedes aegypti Control  
Mosquito Identification  
Project Organization  
and Operation  
Education  
Field Observations

### OTHER ARTHROPOD-BORNE DISEASES

Epidemiology  
Life History and  
Identification of Vectors  
Control

### FOREIGN EXPERIENCES

China-Burma-India  
Theatre  
Pacific Theatre  
Middle Eastern Theatre  
European Theatre  
American Theatre



## ULTIMATE AIMS IN MALARIA EDUCATION

By means of positive malaria educational activities, an element of permanence may be built into the Extended Program. This will insure maximum effectiveness and long range benefits. An extensive malaria educational program should stimulate people to recognize the malaria problem and to meet their responsibilities in malaria prevention, as well as achieve the immediate goal of the Extended Program.

The program includes larvicidal control and incidental drainage in approved communities. If these communities are stimulated to contribute material and other assistance, they will not only benefit from the permanent drainage which is installed, but control efforts will be a matter of community interest and pride - something done by the community instead of for the community by outsiders. Under such conditions, the community is far more likely to feel the necessity for maintaining such control measures and for assuming responsibility for protection from malaria and other mosquito-borne diseases.



Result of Individual Stimulation

The effect of malaria education on the individual will in a sense follow that of the community as a whole. It will increase the individual's own understanding of the malaria problem and will add significance in terms of his own welfare to the proj-

ects being carried on. He will be stimulated to add to the effectiveness of these control procedures by mosquito proofing his house, by reducing mosquito breeding on his own premises, and by employing other individual protective measures.

The successful Army and Navy malaria control programs, both in this country and overseas, have repeatedly stressed the importance of the individual in their malaria control activities. Both have carried out extensive educational campaigns to impress the individual with his responsibility in protecting himself against malaria. Under combat conditions in malarious theatres, the control of malaria is almost solely dependent upon individual understanding of the problem and individual initiative to do something about it. Hence, troops are constantly informed in regard to the malaria hazard and are thoroughly trained in "malaria discipline." When these men are returned to the States, they will bring back attitudes and an understanding of the problem which should be helpful in general malaria education in their communities.

Malaria is a preventable disease. If the knowledge and facilities now at our disposal can be used to their fullest extent, there should be no necessity for the continued existence of the disease in this country.

The Extended Program is aimed primarily at the immediate hazard of returning malaria carriers. But its proposed concentrated attack coupled with its comprehensive program of malaria education may have a more far-reaching effect. With remarkable new insecticides at our disposal, with the hope for new and more effective drugs to use in treatment, and with a tremendous increase in public awareness of the problem and of what can be done about it, we may find malaria reduced to such a low point that it will be unable to maintain itself. Malaria has already disappeared from large sections of this country. With the fullest cooperation of all concerned, not only will the problem of returning malaria carriers be met, but the disease may be eliminated from the remainder of the United States.



TABLE II

## MCWA EXPENDITURES AND LIQUIDATIONS BY MAJOR ITEMS

DECEMBER 1944

	Continental U. S.	Percentage of Total	Puerto Rico	Percentage of Total
.01 Personal Services	\$ 372,474.15	74.62	18,568.44	89.09
.02 Travel	25,944.78	5.19	5.75	.04
.03 Transportation of Things	5,168.74	1.04	200.00	.96
.04 Communication Services	1,080.35	.22	13.40	.07
.05 Rents and Utilities	2,159.71	.43	---	---
.06 Printing and Binding	1,786.35	.36	---	---
.07 Other Contractual Services	3,040.70	.62	---	---
.08 Supplies and Materials	54,066.48	10.83	2,021.54	9.71
.09 Equipment	33,418.00	6.69	36.00	.13
Total	\$ 499,139.26	100.00	20,845.13	100.00
Expenses other than Personal Services	126,665.11	25.38	2,276.69	10.91

TABLE III

## MCWA PERSONNEL ON DUTY AND TOTAL PAYROLL

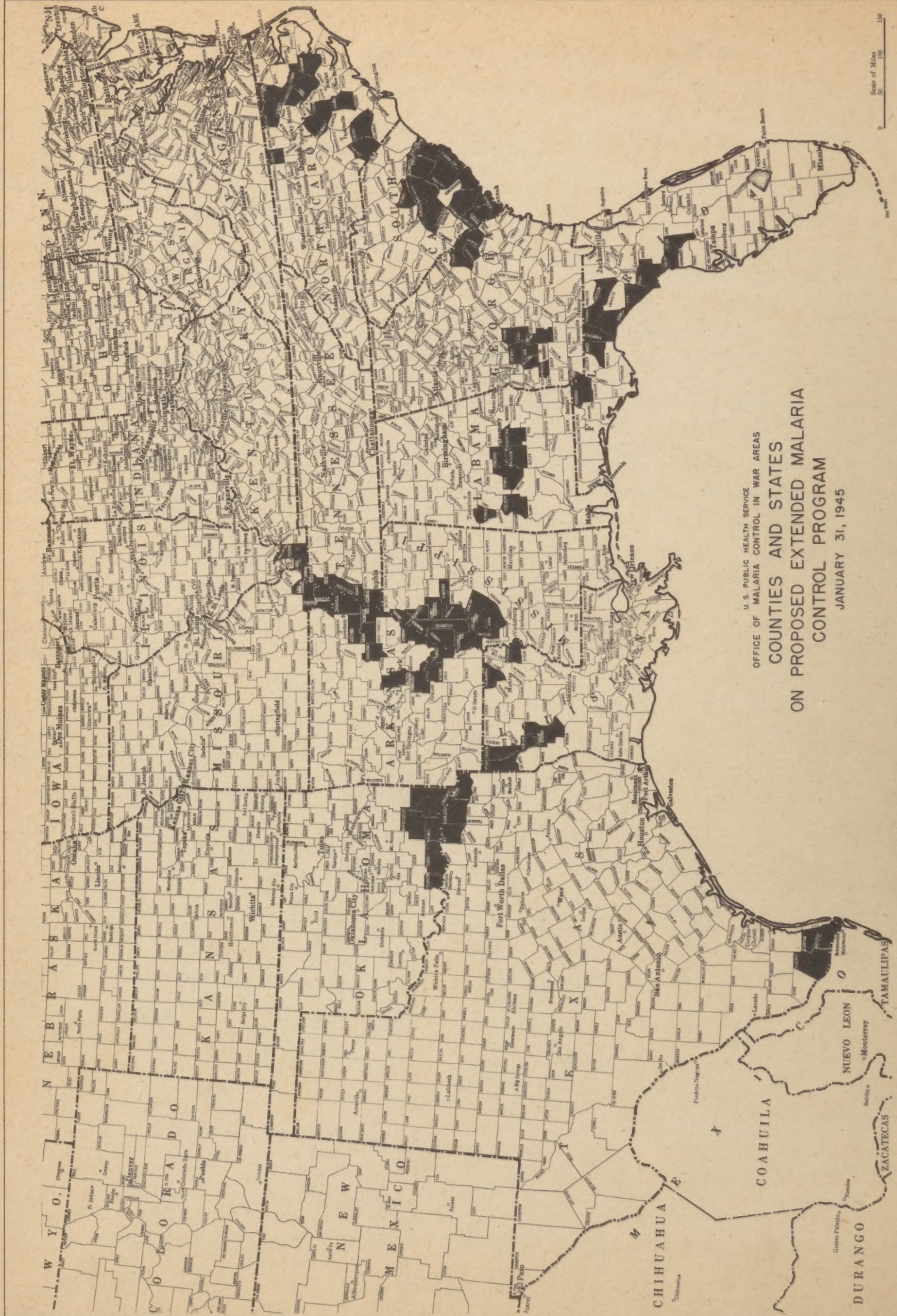
DECEMBER 1944

State	Commissioned		Prof. & Sci.		Sub-Prof. (1)		C. A. F.		Custodial and Per Hour		Total		Percent of Total	
	No.	Pay	No.	Pay	No.	Pay	No.	Pay	No.	Pay	No.	Pay	No.	Pay
Alabama	4	1,140	1	264	3	548	1	183	25	3,247	34	5,382	1.30	1.38
Arkansas	8	2,417	6	1,604	29	5,406	4	896	116	13,850	163	24,173	6.20	6.18
California	4	1,104	---	---	5	863	3	622	17	2,842	29	5,431	1.10	1.39
Dist. of Columbia	1	333	---	---	1	203	1	233	---	---	3	769	.11	.20
Florida	8	2,219	6	1,749	20	4,077	6	1,135	149	20,184	189	29,364	7.20	7.51
Georgia	8	2,434	2	527	38	7,214	6	997	85	11,580	139	22,752	5.30	5.82
Illinois	6	1,940	---	---	---	---	3	567	2	163	11	2,670	.42	.68
Indiana	---	---	---	---	---	---	---	---	1	176	1	176	.04	.04
Kentucky	3	855	2	537	2	501	1	164	5	281	13	2,338	.60	.60
Louisiana	12	3,460	4	1,237	43	8,667	6	1,061	210	28,881	275	43,306	10.48	11.07
Maryland	2	533	---	---	2	385	2	438	12	1,683	18	3,039	.69	.78
Mississippi	6	1,807	5	1,206	8	1,807	4	566	78	9,169	99	14,555	3.77	3.72
Missouri	3	1,000	---	---	10	1,973	4	769	12	1,570	29	5,312	1.10	1.36
North Carolina	5	1,522	4	1,297	6	1,213	4	726	128	16,794	147	21,552	5.60	5.51
Oklahoma	5	1,500	1	274	12	2,543	1	164	28	3,762	47	8,243	1.79	2.10
Oregon	---	---	---	---	1	203	---	---	---	---	1	203	.04	.05
Puerto Rico	8	2,352	1	297	3	679	5	1,085	305	14,155	322	18,568	12.27	4.75
South Carolina	5	1,520	8	2,127	26	5,546	5	867	255	31,455	299	41,515	11.39	10.62
Tennessee	5	1,573	3	841	7	1,452	3	584	44	4,775	62	9,225	2.36	2.36
Texas	7	2,052	4	1,289	25	5,557	6	1,058	176	22,516	218	32,472	8.30	8.30
Virginia	2	619	2	696	11	2,366	3	602	104	12,738	122	17,021	4.65	4.35
<u>AEDES AEGYPTI</u>														
Alabama	1	285	---	---	8	1,485	1	146	---	---	10	1,916	.38	.49
Florida	1	285	1	274	29	5,349	2	292	---	---	33	6,200	1.26	1.59
Georgia	---	---	---	---	6	1,053	---	---	---	---	6	1,053	.23	.27
Louisiana	1	285	1	274	10	1,970	1	164	---	---	15	2,693	.50	.69
South Carolina	1	285	---	---	10	1,663	1	164	---	---	12	2,112	.46	.54
Texas	4	1,140	---	---	26	5,090	2	310	6	861	38	7,401	1.44	1.89
Hq. & Dist. (2)	72	22,399	6	1,707	42	8,262	126	21,342	29	4,145	275	57,855	10.47	14.80
Mobile Units	6	1,900	3	669	2	230	3	604	3	343	17	3,746	.65	.96
Total	188	56,959	60	16,869	385	76,305	204	35,739	1,788	205,170	2,626	391,042	100.00	100.00
Percent of Total	7.16	14.57	2.29	4.31	14.67	19.51	7.77	9.14	68.11	52.47	100.00	100.00		

(1) Includes Entomological Inspectors

(2) Includes Headquarters and District Offices, malaria survey, Imported malaria control, special investigations, and employees temporarily attached to Headquarters pending assignment to States.





U.S. PUBLIC HEALTH SERVICE  
OFFICE OF MALARIA CONTROL IN WAR AREAS  
**COUNTIES AND STATES  
ON PROPOSED EXTENDED MALARIA  
CONTROL PROGRAM**  
JANUARY 31, 1945